

CLAIMS

1. An air-conditioning system for conditioning air by removing heat and moisture from the air and transferring it to the environment, comprising:
  - 5 a dehumidifier that produces dehumidified air and utilizes a liquid desiccant for drying;  
at least one non-desiccant fluid at a temperature lower than the temperature of the liquid desiccant; and  
at least one heat exchanger in which the liquid desiccant is cooled by the at least  
10 one fluid.
2. An air-conditioning system according to claim 1, wherein at least one of the at least one fluids comprises water.
- 15 3. An air-conditioning system according to claim 1 or claim 2, wherein at least one of the at least one fluids comprises air.
4. An air-conditioning system according to claim 2 or claim 3, and including at least one cooling chamber through which air flows, and which contains water which evaporates  
20 into said air, wherein the at least one fluid comprises one or both of air exiting at least one of the at least one cooling chambers and water cooled in at least one of the at least one cooling chambers.
5. An air-conditioning system according to claim 4, wherein the water in at least one  
25 of the at least one cooling chambers is sprayed into the air in said cooling chamber.
6. An air-conditioning system according to claim 4 or claim 5, wherein at least some of the air flowing through at least one of the at least one cooling chambers comprises at least some of the dehumidified air produced by the dehumidifier.  
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7. An air-conditioning system according to any of claims 4-6, wherein at least some of the air flowing through at least one of the at least one cooling chambers comprises air that has not been dehumidified by the dehumidifier.

8. An air-conditioning system according to any of claims 4-7, wherein at least one of the at least one heat exchangers is in thermal contact with at least one of the at least one cooling chambers.

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9. An air-conditioning system according to any of claims 4-8, and including a desiccant pump which pumps the desiccant through at least one of the at least one heat exchangers.

10 10. An air-conditioning system according to any of claims 4-8, and including a desiccant reservoir, wherein the liquid desiccant utilized by the dehumidifier is contained at least part of the time in the desiccant reservoir, and at least one of the at least one heat exchangers is in thermal contact with the desiccant reservoir.

15 11. An air-conditioning system for conditioning air by removing heat and moisture from the air and transferring it to the environment, comprising:

a dehumidifier which produces dehumidified air;

at least one cooling chamber through which air flows, and which contains water which evaporates into said air; and

20 at least one heat exchanger in which at least some of the dehumidified air is cooled by one or both of air exiting at least one of the at least one cooling chambers or water cooled in at least one of the at least one cooling chambers.

12. An air-conditioning system according to claim 11, wherein the dehumidifier  
25 utilizes a liquid desiccant for drying, and the liquid desiccant is cooled in at least one of the at least one heat exchangers by one or both of air exiting at least one of the at least one cooling chambers or water cooled in at least one of the at least one cooling chambers.

13. An air-conditioning system according to claim 12, wherein the at least one heat  
30 exchangers comprise a first heat exchanger in which the liquid desiccant is cooled, and a second heat exchanger in which at least some of the dehumidified air is cooled.

14. An air-conditioning system according to claim 13, wherein the at least one cooling chambers comprise a first cooling chamber and a second cooling chamber, wherein one or both of the air exiting from the first cooling chamber or the water cooled in the first cooling chamber is used to cool the liquid desiccant, and one or both of the air exiting  
5 from the second cooling chamber or the water cooled in the second cooling chamber is used to cool at least some of the dehumidified air.
15. An air-conditioning system according to any of claims 12-14, wherein air exiting at least one of the at least one cooling chambers is used to cool the liquid desiccant.
- 10 16. An air-conditioning system according to any of claims 12-15, wherein water cooled in at least one of the at least one cooling chambers is used to cool the liquid desiccant.
- 15 17. An air-conditioning system according to any of claims 12-16, and including a desiccant pump which pumps the desiccant through at least one of the at least one heat exchangers.
- 20 18. An air-conditioning system according to any of claims 12-16, and including a desiccant reservoir, wherein the liquid desiccant utilized by the dehumidifier is contained at least part of the time in the desiccant reservoir, and at least one of the at least one heat exchangers is in thermal contact with the desiccant reservoir.
- 25 19. An air-conditioning system according to any of claims 11-18, wherein the water in at least one of the at least one cooling chambers is sprayed into the air in said cooling chamber.
- 30 20. An air-conditioning system according to any of claims 11-19, wherein at least some of the air flowing through at least one of the at least one cooling chambers comprises at least some of the dehumidified air produced by the dehumidifier.

21. An air-conditioning system according to any of claims 11-20, wherein at least some of the air flowing through at least one of the at least one cooling chambers comprises air that has not been dehumidified by the dehumidifier.
- 5 22. An air-conditioning system according to any of claims 11-21, wherein air exiting at least one of the at least one cooling chambers is used to cool the dehumidified air.
23. An air-conditioning system according to any of claims 11-22, wherein water cooled in at least one of the at least one cooling chambers is used to cool the dehumidified  
10 air.
24. An air-conditioning system according to any of claims 11-23, wherein at least one of the at least one heat exchangers is in thermal contact with at least one of the at least one cooling chambers.  
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25. A dehumidifier for removing moisture from air to be dried and transferring it to environmental air, comprising:  
liquid desiccant;  
a dehumidifying section;  
20 a dehumidifying section reservoir containing at least some of the liquid desiccant;  
and  
at least one dehumidifying section element;  
wherein each dehumidifying section element moves from the dehumidifying section reservoir to the dehumidifying section, carrying some of the desiccant from the  
25 dehumidifying section reservoir with it, which desiccant absorbs moisture from the air to be dried in the dehumidifying section, and the said dehumidifying section element then moves back to the dehumidifying section reservoir, carrying the desiccant back to the dehumidifying section reservoir.
- 30 26. A dehumidifier for removing moisture from air to be dried and transferring it to environmental air, comprising:  
liquid desiccant;

a dehumidifying section where the liquid desiccant removes moisture from the air to be dried;

a regenerating section;

a regenerating section reservoir containing at least some of the liquid desiccant;

5 and

at least one regenerating section element;

wherein each regenerating section element moves from the regenerating section reservoir to the regenerating section, carrying some of the desiccant from the regenerating section reservoir with it, which desiccant gives up moisture to the environmental air in the regenerating section, and the said regenerating section element then moves back to the regenerating section reservoir, carrying the desiccant back to the regenerating section reservoir.

27. A dehumidifier according to claim 25, and including:

15 a regenerating section;

a regenerating section reservoir containing at least some of the liquid desiccant;

and

at least one regenerating section element;

wherein each regenerating section element moves from the regenerating section reservoir to the regenerating section, carrying some of the desiccant from the regenerating section reservoir with it, which desiccant gives up moisture to the environmental air in the regenerating section, and the said regenerating section element then moves back to the regenerating section reservoir, carrying the desiccant back to the regenerating section reservoir.

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28. A dehumidifier according to claim 27, wherein at least one of the at least one dehumidifying section elements moves continuously.

29. A dehumidifier according to claim 27 or claim 28, wherein at least one of the at least one dehumidifying section elements moves intermittently.

30. A dehumidifier according to any of claims 27-29, wherein the rate at which the desiccant carried by at least one of the at least one dehumidifying section elements is

replaced by desiccant from the dehumidifying section reservoir depends on the rate at which the desiccant carried by said dehumidifying section element absorbs moisture from the air to be dried.

- 5 31. A dehumidifier according to claim 30, and including a sensor which senses the amount of moisture absorbed by the desiccant in at least one of the at least one dehumidifying section elements, and a controller which causes said dehumidifying section element to move or to move faster when the absorbed moisture exceeds a given level.
- 10 32. A dehumidifier according to any of claims 27-31, wherein the air to be dried moves through the dehumidifying section, and said motion of the air to be dried causes or contributes to causing at least one of the at least one dehumidifying section elements to move.
- 15 33. A dehumidifier according to any of claims 27-32, and including a motor operative to move at least one of the at least one dehumidifying section elements.
34. A dehumidifier according to any of claims 27-33, and including at least one wheel which comprises at least one of the at least one dehumidifying section elements, wherein a  
20 rotating of the wheel comprises the moving of at least one of the at least one dehumidifying section elements that said wheel comprises.
35. A dehumidifier according to any of claims 27-34, and including at least one conveyor belt which comprises at least one of the at least one dehumidifying section  
25 elements, wherein a conveying of the belt comprises the moving of at least one of the at least one dehumidifying section elements that said belt comprises.
36. A dehumidifier according to any of claims 27-35, wherein at least one of the at least one dehumidifying section elements comprises absorbent material.
- 30 37. A dehumidifier according to any of claims 27-36, wherein the desiccant adheres to at least one of the at least one dehumidifying section elements because of viscosity or surface tension.

38. A dehumidifier according to any of claims 27-37, wherein at least one of the at least one dehumidifying section elements comprises at least one hollow space, and wherein the desiccant remains in said space for at least a portion of the movement of the element.
39. A dehumidifier according to any of claims 27-38, and including a dehumidifying section desiccant remover which removes desiccant from at least one of the at least one dehumidifying section elements, after said desiccant has absorbed moisture from the air to be dried in the dehumidifying section, and before said element carries desiccant from the dehumidifying section reservoir to the dehumidifying section for a further drying cycle.
40. A dehumidifier according to claim 39, wherein the removal of desiccant from at least one of the at least one dehumidifying section elements is done by any one or a combination of squeezing, scraping, wiping, and siphoning the said dehumidifying section element.
41. A dehumidifier according to claim 39 or claim 40, wherein the removal of desiccant from at least one of the at least one dehumidifying section elements is done by tipping the said dehumidifying section element.
42. A dehumidifier according to any of claims 26-41, wherein at least one of the at least one regenerating section elements moves continuously.
43. A dehumidifier according to any of claims 26-42, wherein at least one of the at least one regenerating section elements moves intermittently.
44. A dehumidifier according to any of claims 26-43, wherein the rate at which the desiccant carried by at least one of the at least one regenerating section elements is replaced by desiccant from the regenerating section reservoir depends on the rate at which the desiccant carried by said regenerating section element gives up moisture to the environmental air in the regenerating section.

45. A dehumidifier according to claim 44, and including a sensor which senses the amount of moisture absorbed by the desiccant in at least one of the at least one regenerating section elements, and a controller which causes said regenerating section element to move or to move faster when the absorbed moisture falls below a given level.

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46. A dehumidifier according to any of claims 26-44, wherein the environmental air moves through the regenerating section, and said motion of the environmental air causes or contributes to causing at least one of the at least one regenerating section elements to move.

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47. A dehumidifier according to any of claims 26-46, and including a motor operative to move at least one of the at least one regenerating section elements.

48. A dehumidifier according to any of claims 26-47, and including at least one wheel which comprises at least one of the at least one regenerating section elements, wherein a rotating of the wheel comprises the moving of at least one of the at least one regenerating section elements that said wheel comprises.

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49. A dehumidifier according to any of claims 26-48, and including at least one conveyor belt which comprises at least one of the at least one regenerating section elements, wherein a conveying of the belt comprises the moving of at least one of the at least one regenerating section elements that said belt comprises.

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50. A dehumidifier according to any of claims 26-49, wherein at least one of the at least one regenerating section elements comprises absorbent material.

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51. A dehumidifier according to any of claims 26-50, wherein the desiccant adheres to at least one of the at least one regenerating section elements because of viscosity and/or surface tension.

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52. A dehumidifier according to any of claims 26-51, wherein at least one of the at least one regenerating section elements comprises at least one hollow space, and wherein the desiccant remains in said space for at least a portion of the movement of the element.



53. A dehumidifier according to any of claims 26-52, and including a regenerating section desiccant remover which removes desiccant from at least one of the at least one regenerating section elements, after said desiccant has given up moisture to the environmental air in the regenerating section, and before said element carries desiccant from the regenerating section reservoir to the regenerating section for a further regenerating cycle.

54. A dehumidifier according to claim 53, wherein the removal of desiccant from at least one of the at least one regenerating section elements is done by any one or a combination of squeezing, scraping, wiping, and siphoning the said regenerating section element.

55. A dehumidifier according to claim 53 or claim 54, wherein the removal of desiccant from at least one of the at least one regenerating section elements is done by tipping the said regenerating section element.

56. A dehumidifier according to claim 25, wherein at least one of the at least one dehumidifying section elements moves continuously.

57. A dehumidifier according to claim 25 or claim 56, wherein at least one of the at least one dehumidifying section elements moves intermittently.

58. A dehumidifier according to any of claims 25 and 56-57, wherein the rate at which the desiccant carried by at least one of the at least one dehumidifying section elements is replaced by desiccant from the dehumidifying section reservoir depends on the rate at which the desiccant carried by said dehumidifying section element absorbs moisture from the air to be dried.

59. A dehumidifier according to claim 58, and including a sensor which senses the amount of moisture absorbed by the desiccant in at least one of the at least one dehumidifying section elements, and a controller which causes said dehumidifying section element to move or to move faster when the absorbed moisture exceeds a given level.

60. A dehumidifier according to any of claims 25 and 56-59, wherein the air to be dried moves through the dehumidifying section, and said motion of the air to be dried causes or contributes to causing at least one of the at least one dehumidifying section elements to move.

61. A dehumidifier according to any of claims 25 and 56-60, wherein a motor causes or contributes to causing at least one of the at least one dehumidifying section elements to move.

62. A dehumidifier according to any of claims 25 and 56-61, and including at least one wheel which comprises at least one of the at least one dehumidifying section elements, wherein a rotating of the wheel comprises the moving of at least one of the at least one dehumidifying section elements that said wheel comprises.

63. A dehumidifier according to any of claims 25 and 56-62, and including at least one conveyor belt which comprises at least one of the at least one dehumidifying section elements, wherein a conveying of the belt comprises the moving of at least one of the at least one dehumidifying section elements that said belt comprises.

64. A dehumidifier according to any of claims 25 and 56-63, wherein at least one of the at least one dehumidifying section elements comprises absorbent material.

65. A dehumidifier according to any of claims 25 and 56-64, wherein the desiccant adheres to at least one of the at least one dehumidifying section elements because of viscosity or surface tension.

66. A dehumidifier according to any of claims 25 and 56-65, wherein at least one of the at least one dehumidifying section elements comprises at least one hollow space, and wherein the desiccant remains in said space for at least a portion of the movement of the element.

67. A dehumidifier according to any of claims 25 and 56-66, and including a dehumidifying section desiccant remover which removes desiccant from at least one of the at least one dehumidifying section elements, after said desiccant has absorbed moisture from the air to be dried in the dehumidifying section, and before said element carries  
5 desiccant from the dehumidifying section reservoir to the dehumidifying section for a further drying cycle.

68. A dehumidifier according to claim 67, wherein the removal of desiccant from at least one of the at least one dehumidifying section elements is done by any one or a  
10 combination of squeezing, scraping, wiping, and siphoning the said dehumidifying section member.

69. A dehumidifier according to claim 67 or claim 68, wherein the removal of desiccant from at least one of the at least one dehumidifying section elements is done by  
15 tipping the said dehumidifying section element.